

REMARKS

Prior to entry of this amendment, claims 1-20 are currently pending in the subject application.

Applicants note with appreciation the Examiner's acknowledgement of Applicants' claim for foreign priority and receipt of a certified copy of the priority document.

Applicants also note with appreciation the Examiner's acceptance of the drawings filed on April 20, 2004.

Applicants further note with appreciation the Examiner's consideration of applicants' Information Disclosure Statement filed November 10, 2004.

Claims 6-16, 19, and 20 have been allowed by the Examiner.

Claims 1-5 and 17-18 are presented to the Examiner for further prosecution on the merits.

A. Introduction.

In the outstanding Office action, the Examiner rejected claims 17 and 18 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, rejected claims 1-3 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,890,370 to Fukuda et al. ("the Fukuda reference"), and rejected claims 1 and 2 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,486,751 to Barber et al. ("the Barber reference").

B. Objection to claim 8.

The Examiner objected to claim 8 as containing a typographical error in the word --patterning-- which was originally presented as "pattering." In response, Applicants have corrected the typographical error, and it is respectfully requested that the objection to claim 8 be withdrawn.

C. Rejection of claims 17 and 18 under 35 U.S.C. §112, second paragraph.

In the outstanding Office action, the Examiner rejected claims 17 and 18 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Examiner has stated that, as depending from claim 4, claim 17 lacks antecedent basis, and claim 18 lacks antecedent basis for the limitation “the dry-etching”. Applicants have amended claim 17 to depend from independent claim 6 and amended claim 18 to depend from claim 17.

Accordingly, favorable reconsideration and withdrawal of the rejections of claims 17 and 18 are respectfully requested.

D. Rejection of claims 1-3 under 35 U.S.C. § 102(b) - Fukuda et al. reference.

Claims 1-3 were rejected under 35 U.S.C. §102(b) as being anticipated by the Fukuda et al. reference. The rejection is respectfully traversed.

Applicants have amended claims 1-3 to more clearly recite aspects of the invention.

Independent claim 1, as amended, recites limitations not taught, shown, or suggested by the Fukuda et al. reference. The Fukuda et al. reference teaches an acoustic piezo-electric resonator having a cavity (“air gap”) 37a. The cavity 37a is disposed in a layer 36 formed between a layer 32 (“first resistance layer”) buried in a silicon substrate 31 and a layer 33 (“membrane layer”) formed on the substrate 31. The buried layer 32 is formed by implanting oxygen ions into the substrate 31 using ion implantation and SIMOX processes. The layer 36 is essentially an upper portion of the substrate 31 and is disposed above the buried layer 32. To form the cavity 37a, the layer 36 is entirely removed in area 37 between the layers 32 and 33 (FIGS. 1(a)-1(e), and 2(a)-2(b); col. 3, lines 32 – 63).

The Examiner's attention is directed to the fact that the Fukuda et al. reference teaches to form the cavity 37a in the substrate 31 by entirely removing the material of the substrate between a layer buried in the substrate (layer 32) and a layer formed on the substrate (layer 33).

In contrast, in Applicants' acoustic resonator, an air gap 130 is accomplished as a recess (position 112') that is developed in a first resistance layer (layer 112) formed on a surface of the substrate 111, whereas a membrane layer (layer 116) is formed on the first resistance layer. As such, the air gap ("cavity") is disposed not in the substrate, but above the substrate, as recited in claim 1. In particular, amended claim 1 positively recites:

A film bulk acoustic resonator, comprising:
a semiconductor substrate;
a first resistance layer formed on a surface of the semiconductor substrate, the first resistance layer having a recess;
a membrane layer formed on the first resistance layer over the recess, thereby forming in the recess an air gap region of the acoustic resonator;
a first electrode formed on the membrane layer;
a piezoelectric layer formed on the membrane layer and an exposed portion of the first electrode; and
a second electrode formed on the piezoelectric layer.
(emphasis added).

Support for the amendment can be found in the Specification at paragraphs [0029] – [0030] and in FIGS. 3D-3K.

Specifically, the Fukuda et al. reference does not teach an acoustic resonator where (i) a first resistance layer is formed on a surface of the substrate and comprises a recess, and (ii) a membrane layer is formed on the first resistance layer over the recess, thus creating in the recess an air gap region of the acoustic resonator. As such, Applicants contend that claim 1 is patentably distinguishable from this reference.

Furthermore, claims 2-3 depend, either directly or indirectly, from claim 1 and recite additional features therefor. Since the Fukuda et al. reference does not disclose or suggest and does not teach each and every element of Applicants' invention as recited in claim 1, dependent claims 2-3 are also not anticipated and are allowable.

Accordingly, Applicants respectfully submit that claims 1-3 are patentable over the Fukuda et al. reference, and respectfully request favorable reconsideration and withdrawal of the rejection of claims 1-3.

E. Rejection of claims 1 and 2 under 35 U.S.C. § 102(b) - Barber et al. reference.

Claims 1-2 were rejected under 35 U.S.C. § 102(b) as being anticipated by the Barber et al. reference. The rejection is respectfully traversed.

Applicants have amended claims 1 and 2 to more clearly recite aspects of the invention.

Independent claim 1, as amended, recites limitations not disclosed, taught, or suggested by the Barber et al. reference. The Barber et al. reference teaches an acoustic piezo-electric resonator having a plurality of columnar piezo-electric structures 24. A cavity ("air gap") 30 of the resonator is formed in a high resistivity layer 36. The layer 36 is sandwiched between (i) a membrane layer 32 and a substrate 12 (shown in FIG. 6), or (ii) between the first electrode layer 18 and the substrate 12 (shown in FIG. 7). To form the cavity 30, the layer 36 is entirely removed either in a region between the layer 32 and the substrate or in a region between the layer 18 and the substrate, respectively (col. 5, lines 28-57; FGS. 6-7).

The Examiner's attention is directed to the fact that the Barber et al. reference teaches to form the cavity 30 by entirely removing the material of the high resistivity layer 36 and, as such, teaches exposing a surface of the substrate 12 beneath the piezo-electric resonator. In such a

structure, a surface of the substrate 12 forms a lower boundary of the cavity of the acoustic resonator.

In contrast, in Applicants' acoustic resonator, an air gap ("cavity") 130 is accomplished as a recess (position 112') developed in a first resistance layer (layer 112) formed on a substrate 111. As such, the air gap is formed in the recess in the first resistance layer and separated from the substrate, as recited in claim 1. In particular, amended claim 1 positively recites:

A film bulk acoustic resonator, comprising:
a semiconductor substrate;
a first resistance layer formed on a surface of the semiconductor substrate, the first resistance layer having a recess;
a membrane layer formed on the first resistance layer over the recess, thereby forming in the recess an air gap region of the acoustic resonator;
a first electrode formed on the membrane layer;
a piezoelectric layer formed on the membrane layer and an exposed portion of the first electrode; and
a second electrode formed on the piezoelectric layer.
(emphasis added).

Support for the amendment can be found in the Specification at paragraphs [0029] – [0030] and in FIGS. 3D-3K.

Specifically, the Barber et al. reference does not teach an acoustic resonator where (i) a first resistance layer comprises a recess, and (ii) a membrane layer is formed on the first resistance layer over the recess, thus creating in the recess an air gap region of the acoustic resonator. As such, Applicants submit that claim 1 is patentably distinguishable over the Barber et al. reference.

Furthermore, claim 2 depends directly from claim 1 and recites additional features therefor. Since the Barber et al. reference does not disclose or suggest and does not teach each

and every element of Applicants' invention recited in claim 1, Applicants submit that dependent claim 2 is patentably distinguished and allowable thereover.

Thus, Applicants submit that claims 1-2 are patentable over the Barber et al. reference. Accordingly, favorable reconsideration and withdrawal of the rejection of claims 1-2 under 35 U.S.C. § 102(b) based on the Barber et al. reference is respectfully requested.

F. Allowable Subject Matter.

Dependent claims 4 and 5 were objected to as being dependent upon a rejected base claim, but indicated as being allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants acknowledge with appreciation the Examiner's indication of allowability of claims 4 and 5. However, as independent claim 1, from which claims 4 and 5 depend, is allowable over the prior art of record for the reasons set forth above, Applicants respectfully submit that claims 4 and 5 are also allowable as being dependent on an allowable base claim.

G. Conclusion.

Since the cited prior art references fail to anticipate the subject invention as presently claimed, applicants respectfully submit that all pending claims 1-20 are now in condition for allowance, and a notice to that effect is respectfully requested.

If the Examiner believes that additional discussions or information might advance the prosecution of the instant application, the Examiner is invited to contact the undersigned at the telephone number listed below to expedite resolution of any outstanding issues.

In view of the foregoing amendments and remarks, reconsideration of this application is earnestly solicited, and an early and favorable further action upon all the claims is hereby requested.

Respectfully submitted,

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PETITION and
DEPOSIT ACCOUNT CHARGE AUTHORIZATION

This document and any concurrently filed papers are believed to be timely. Should any extension of the term be required, applicant hereby petitions the Director for such extension and requests that any applicable petition fee be charged to Deposit Account No. 50-1645.

If fee payment is enclosed, this amount is believed to be correct. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-1645.

Any additional fee(s) necessary to effect the proper and timely filing of the accompanying-papers may also be charged to Deposit Account No. 50-1645.